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(71) Applicant: SHIMANO INC.  
Osaka (JP)

(72) Inventor: Okajima, Shinpei  
Sakai-shi, Osaka (JP)

(74) Representative:  
Dreiss, Fuhlendorf, Steimle & Becker,  
Patentanwälte  
Postfach 10 37 62  
70032 Stuttgart (DE)

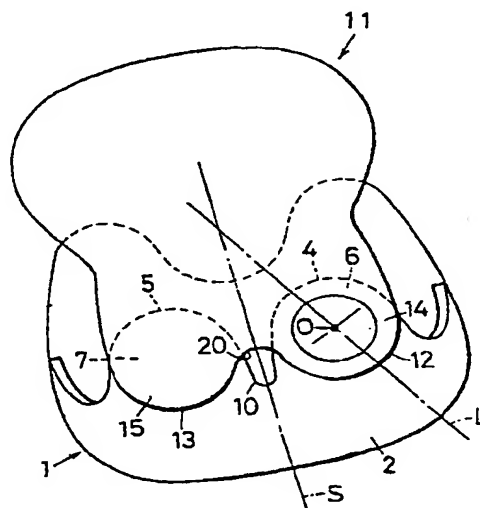
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A request for correction of pages 22 and 23 has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) Snow boot

(57) In a snowboard boot comprising a heel member 1 contained in the heel section and a leg section positioned above said heel member 1, the upper portion of the rigid heel member 1 and the lower portion of a leg section rigid member 11 are overlapped in the longitudinal direction, with the leg section rigid member 11 being capable of approximate rotation with respect to the rigid heel member 1 around an axis L that passes through an offset location offset to the outside with respect to the plane of approximate symmetry S which divides the left and right sections of the heel section 2 into approximately symmetrical portions, and that intersects the plane of approximate symmetry S, thus increasing the efficiency of transmission of propulsive force and improving control.

[ Figure 1 ]



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## Description

The present invention relates to a snowboard boot. In particular, it relates to a snowboard boot in which the leg section can tilt freely with respect to the sole section or the heel section in the direction of travel.

Snowboards differ from skis, which are used in pairs, in that only a single board is used. The rider rides on the snowboard facing sideways. In other words, the direction of snowboard travel and the lengthwise direction of the rider are approximately perpendicular. Both rigidity and flexibility are required of snowboard boots. Rigidity is required so that the foot is held firmly by the snowboard boot, and flexibility is required so that the ankle can tilt with respect to the sole.

Snowboard boots designed so that the upper and lower regions, particularly the heel section and the cylindrical section or leg section positioned above the heel section, are capable of relative rotation around the approximate centerline of the snowboard boot (hereinafter termed "approximate centerline"; the term "approximate" is used because there is not complete lateral symmetry between the left and right shoes) have been proposed in FR 2 719 197 A1, DE 43 33 503 C2 and DE 36 22 746 A1.

When this type of snowboard boot is used, the ankle can easily swivel or tilt in unison with the snowboard boot in the lateral direction with respect to the snowboard (the direction perpendicular to the lengthwise direction of the rider, the direction of snowboard forward progress/regression). A pivot is used as the swivel design between the heel section and the leg section. The axis of rotation of this pivot lies approximately on the vertical plane which contains the longitudinal line of the snowboard boot.

The snowboard boots are affixed to the snowboard. The left foot is usually the controlling foot in snowboarding. The longitudinal line of the left snowboard boot is inclined towards the direction of travel, i.e., towards the left side, with respect to the major axis of the snowboard, i.e., the direction of forward progress. This angle of incline is usually about 27°. The main reason for this particular angle of incline is that it facilitates vision in the direction of travel.

In order to make the snowboard go forward in the direction of its major axis, the tilt or swivel of the left foot should be directed in the direction of travel. In known swivel designs, the direction of tilt is inclined with respect to the direction of travel. That is, in known swivel designs, the direction of tilt is inclined by 27° with respect to the direction of travel. These known swivel and tilt designs result in a loss of the propulsive force which propels the snowboard in the direction of travel.

The flexible coupling which constitutes the ankle is known to have a three-dimensional arch structure. This three-dimensional arch structure makes it difficult to bend the foot in the lateral direction when in an erect posture. That is, this three-dimensional arch structure hinders tilting movement in the lateral direction that is

not accompanied by forward movement of the ankle. Swivel and tilt designs must therefore take into account this three-dimensional arch structure, as well as the angle of diagonal attachment of the snowboard boot to the snowboard. Swivel and tilt designs must also be reexamined in connection with piping competition, in which strong propulsive force in the direction of travel is required.

The present invention was developed with the foregoing in view, and achieves the following objectives. An objective of the present invention is to provide a snowboard boot that produces minimal loss of propulsive force. A further objective of the present invention is to provide a snowboard boot that permits the foot to be easily tilted in the direction of travel. A further objective of the present invention is to provide a snowboard boot that provides enhanced snowboard motion.

In order to avoid the aforementioned drawbacks and to solve the aforementioned objectives the measures according to claim 1 are adopted.

In the snowboard boot which pertains to the present invention, a structure which has general lateral symmetry is designed to pivot around an axis which intersects the plane of symmetry. Asymmetric internal stress is generated in response to the pivoting force produced by the leg which induces this pivoting motion. This internal stress produces resistance which is greater than the pivoting force in the plane orthogonal to the plane of symmetry, and this resistance acts upon the foot.

This resistance, which differs from the local frictional resistance produced by the entire snowboard boot structure (a multi-layer cylindrical structure comprising three layers, an outer and an inner layer, is extremely stable even over periods of prolonged continuous use. This stability produces smooth pivoting motion.

Tilting motion of the ankle is not motion in the vertical plane in which the axis of the anklebone lies. Motion in the horizontal plane or the vertical plane in which the axis of the anklebone lies is hindered by the three-dimensional arch structure of the ankle. The three-dimensional arch structure of the ankle is a three-dimensional rotation support structure that can tilt to the left or right while inclining forward, while hindering tilting motion to the left or right when there is no change in the angle of forward inclination; it is thus not an unrestrained universal structure.

Tilting motion of the ankle in the lateral direction is facilitated when it is accompanied by tilting motion in the longitudinal direction. Due to the aforementioned three-dimensional structure, pivoting motion in a pivoting plane which is inclined with respect to the vertical plane in which the axis of the anklebone lies is easier than pivoting motion in the vertical plane in which the axis of the anklebone lies. The tilting design which pertains to the present invention is consistent with this three-dimensional arch structure of the ankle. Thus, it facilitates tilting motion of the ankle and minimizes the loss of

propulsive force.

When the snowboard boot is attached such that it is inclined diagonally with respect to the major axis of the snowboard, i.e., to the direction of travel, pivoting motion of the foot in the diagonal direction provides propulsive force in the direction of travel to the snowboard boot, which has been attached to the snowboard so as to lie diagonal to the orthogonal plane which extends orthogonally to the direction of travel. Since the rotational force (the component force which acts so as to rotate the snowboard) is zero or very small, the loss in propulsive force produced by the foot acting on the snowboard is minimized, and this propulsive force therefore has high propulsive efficiency. This high propulsive efficiency is useful in piping competitions.

The snowboard boot which pertains to the present invention can be used with a step-in type snowboard. Cleats are attached to the snowboard boot. The snowboard is provided with an engagement mechanism in which the cleats are engaged by a step-in system. The disk to which the snowboard boot is attached is stationary at the desired rotation position. The axis of rotation rotates in tandem with the snowboard boot so that the angular relationship of the snowboard boot and the snowboard changes.

Preferred embodiments of this snowboard boot are described according to the features of anyone of subclaims 2 to 11 or of an arbitrary combination of them.

Further embodiments of this invention may be expressed as follows: both, the aforementioned axis of rotation on the left foot side and the aforementioned axis of rotation on the right foot side are inclined and intersect; the angle formed by the aforementioned plane of approximate symmetry and the aforementioned inclined plane is smaller than the angle formed by the aforementioned plane of approximate symmetry and the orthogonal plane which lies orthogonal to the major axis of the snowboard to which said snowboard boot is attached; the aforementioned angle formed by the aforementioned plane of approximate symmetry and the aforementioned inclined plane is within the range of 23° to 33° for the foot located forward in the direction of travel, and the angle formed by the aforementioned plane of approximate symmetry and the aforementioned orthogonal plane is within the range of 20° to 30° for the aforementioned foot; the aforementioned angle formed by the aforementioned plane of approximate symmetry and the aforementioned inclined plane is, for both feet, smaller than the angle formed by the aforementioned plane of approximate symmetry and the orthogonal plane which is orthogonal to the major axis of the snowboard to which said snowboard boot is attached; the aforementioned angle formed by the aforementioned plane of approximate symmetry and the aforementioned inclined plane is within the range of 23° to 33° for the aforementioned foot, and the aforementioned angle formed by the aforementioned plane of approximate symmetry and the aforementioned orthogonal plane is within the range of 20° to 30° for the aforementioned

foot; the aforementioned angle formed by the aforementioned plane of approximate symmetry and the aforementioned inclined plane is greater for the foot located forward in the direction of travel than is the aforementioned angle formed by the aforementioned plane of approximate symmetry and the aforementioned inclined plane for the foot located to the rear in the direction of travel.

In the foregoing embodiments, the overlapping members at the offset position can be designed to slide through spherical contact. The arc seen when the sliding surface is viewed in cross section can be an approximate arc, and the curved surface comprising a group of arcs can have the shape of an elliptical surface or a spherical surface. Where the top section is to pivot in the longitudinal direction as well, a curved surface which allows for pivoting in the longitudinal direction is used.

#### Brief Description of the Drawings:

Figure 1 is an inclined projection of a first embodiment of the snowboard boot which pertains to the present invention;

Figure 2 is a top cross section of Figure 1;

Figure 3 is a cross section of Figure 2 along line III-III;

Figure 4 is an inclined projection of a second embodiment of the snowboard boot which pertains to the present invention;

Figure 5 is a top cross section of Figure 4;

Figure 6 is a cross section of Figure 5 along line VI-VI;

Figure 7 is a top view of a third embodiment of the snowboard boot which pertains to the present invention;

Figure 8 is a left side cross section of Figure 7;

Figure 9 is a plan view of Figure 7;

Figure 10 is a top view depicting the positional relationship of the snowboard boots and the snowboard;

Figure 11 is an inclined projection depicting bending motion of the foot for both feet;

Figure 12 is an inclined projection depicting bending motion of the foot for the left foot.

## Description of the Preferred Embodiments

### First Embodiment:

A first embodiment of the snowboard boot which pertains to the present invention will now be described. Ordinary shoes have a rigid sole, a rigid heel section, and a rigid toe section. This rigid sole material is covered by a soft insole member and by other facing materials. A rigid sole is used in snowboard boots.

In order to reinforce the heel member, a rigid member (termed a heel cup, etc.) is attached on the inside or the outside of the facing material. The rigid member of the heel member is affixed to the sole or facing material in the heel section by stitching or bonding. The rigid heel component consists of a rigid material such as nylon 66.

Figure 1 depicts a rigid heel component 1 which comprises a heel cup attached at the inside of the shell of the snowboard boot. The rigid heel component 1 is a heel component consisting of a heel section 2. The inside and outside surfaces of the heel section 2 are bowed such that the outside has convex curvature. The rigid heel component 1 extends out to form a continuous bottom section 3 that is bonded to the sole (not shown). The right and left shoes are usually positioned in mirror symmetry to each other, but the left and right shoes are not themselves symmetrical.

However, the heel section in each shoe is laterally symmetrical. When the shoe is placed on a horizontal plane, the heel section is approximately symmetrical with respect to a vertical plane which contains a line in the longitudinal direction. This approximately symmetrical plane is referred to in the Specification and in the Claims as the "plane of approximate symmetry".

In Figure 1, the right side of the plane of approximate symmetry S is the outside and the left side of the plane of approximate symmetry S is the inside. The rigid heel component 1 depicted in the drawing is for the right foot. The top edge at the back of the heel section 2 has a curved shape that is symmetrical with respect to the plane of approximate symmetry S. This curve comprises an outside upward-protruding line or segment 4, an inside upward-protruding line or segment 5, and a central concave line or segment 10 that is projected concavely downward at the center.

The heel section 2 has an outside protrusion 6 and an inside protrusion 7 whose shapes are defined by the outside upward-protruding line or segment 4 and the inside upward-protruding line or segment 5. The outside upward-protruding line or segment 4 and the inside upward-protruding line or segment 5 are convex at their tops.

A leg section rigid member 11, contained in the leg section, is located above the rigid heel member 1. The rigid material used for the leg section rigid member 11 is softer than that used for the rigid heel member 1. The leg section rigid member 11 is a member that provides support to the back of the ankle. Where the rigid heel member 1 is termed the bottom section of the rigid

member, the leg section rigid member 11 may be termed the top section of the rigid member.

The lower edge at the bottom of the leg section rigid member 11 has a curved shape that is symmetrical with respect to the plane of approximate symmetry S. This curve comprises an outside downward-protruding line or segment 12, an inside downward-protruding line or segment 13, and a central convex line or segment 20 that is projected convexly upward at the center.

The outside downward-protruding line or segment 12 and the inside downward-protruding line or segment 13 are projected convexly downward. The leg section rigid member 11 has an outside protrusion 14 and an inside protrusion 15 whose shapes are defined by the outside downward-protruding line or segment 12 and the inside downward-protruding line or segment 13. The outside protrusion 6 and the outside protrusion 14 overlap in the longitudinal direction.

The inside protrusion 7 and the inside protrusion 15 also overlap in the longitudinal direction. The issue of which protrusions are placed in front is a matter of design. In the following discussion, the outside protrusion 6 and the inside protrusion 7 are assumed to be positioned in front of the outside protrusion 14 and the inside protrusion 15.

The outside protrusion 6 and the outside protrusion 14 are offset to the right with respect to the plane of approximate symmetry S. The inside protrusion 7 and the inside protrusion 15 are offset to the left. The axis of rotation L is defined as the straight line which passes through this offset center point O (the offset position which is the approximate center position of the offset outside protrusion 6 and the outside protrusion 14) and which intersects the plane of approximate symmetry S. The axis of rotation L also intersects the plane of the sole. The area in which the axis of rotation L intersects the rigid heel member 1 and the leg section rigid member 11 takes the form of a hinge.

The axis of rotation L has a downward slope in the forward direction. The issue of whether the axis of rotation L shall have a downward slope or an upward slope in the forward direction is a matter of design; however, a downward slope is favorable in terms of providing a secure fit in the snowboard boot when the foot is inclined forward.

Figure 2 depicts the overlapping structure of the outside protrusion 6 and the outside protrusion 14. The outside protrusion 14 is fixed by means of a position-fixing rivet 17 in a position which is offset from the outside protrusion 6. The position-fixing rivet 17 is provided with a pivot or rotating shaft 18.

The axis of the rotating shaft 18 is aligned with the axis of rotation L. The face at which the overlapping outside protrusion 6 and the outside protrusion 14 slide together is a spherical face or approximately spherical face 19. The clamping force exerted in the axial direction by the position-fixing rivet 17 is designed to be low in order to minimize frictional force at the spherical face between the outside protrusion 6 and the outside pro-

trusion 14. The outside protrusion 6 and the outside protrusion 14 are coupled so as to be capable of relative rotation.

Figure 2 also depicts the overlapping structure of the inside protrusion 7 and the inside protrusion 15. The inside offset position (the position at which the inside protrusion 7 and the inside protrusion 15 overlap) is designed so as to be located symmetrically to the offset position on the right side (the position at which the outside protrusion 6 and the outside protrusion 14 overlap) with respect to the plane of approximate symmetry S. The overlap face 22 at which the inside protrusion 7 and the inside protrusion 15 overlap has the shape of an arc or a group of arc-shaped curves. In Figure 2, the radius of the arc is indicated by R.

The cross section of the overlap face is an arc or an arc-like shape. The line of the arc or arc-like shape will henceforth be termed "approximate arc 23". Approximate arc 23 is depicted in Figure 3. Figure 3 is a cross section cut along the vertical plane which contains the orthogonal line 24 indicated in Figure 2. The point of intersection of this vertical plane and the axis of rotation L is indicated by P.

The approximate arc 23 is an arc-like curve having point P as its center. The inside protrusion 7 is a part of the rigid heel member 1, which is a thick section 26. The outside surface of the thick section 26 and the inside surface of the inside protrusion 15 together form a group which constitutes approximate arc 23.

In Figure 2, the direction of snowboard travel is indicated by the arrow 31. The case of propulsive force being exerted on the snowboard towards the right side in Figure 2 will be described. When the right ankle is bent downward in the direction of the sole or of snowboard travel (towards the upper left of the drawing), the rigid leg section member 11, whose curvature conforms to the back of the ankle, attempts to bend down together with the ankle towards the inside (the direction of travel side; towards the left leg). When the rigid leg section member 11 is subjected to this pivoting force or thrust, it tilts and rotates in the counterclockwise direction with the free rotation center point (point O) as the center of rotation. The inside protrusion 7 and the inside protrusion 15 are in contact via the arc 23 and slide smoothly.

This tilting occurs on a plane which intersects the plane of approximate symmetry S of the snowboard boot, so resistance is produced by the snowboard boot, which has an approximately symmetrical design with respect to the plane of approximate symmetry S. This resistance, which is produced by the structure comprising the rigid heel member 1 and the leg section rigid member 11 that are in contact through a curved face, restricts the pivoting force against the rigid heel member 1 and the leg section rigid member 11 so that excessive pivoting is prevented.

This resistance, which does not depend upon sliding frictional force between the outside protrusion 6 and the outside protrusion 14 or sliding frictional force between the inside protrusion 7 and the inside protrusion

15, is determined by the three-dimensional arch structure of the snowboard boot, and is thus always held stable at an essentially constant level. The concave section formed between the outside protrusion 6 and the inside protrusion 7 allows the rigid heel member 1 to deform smoothly. The concave section formed between the outside protrusion 14 and the inside protrusion 15 allows the leg section rigid member 11 to deform smoothly. The propulsive force of the snowboard will be discussed in greater detail later.

#### Second Embodiment:

Figures 4, 5, and 6 depict a second embodiment of the snowboard boot which pertains to the present invention. Figures 4, 5, and 6 are identical to Figures 1, 2, and 3, except with regard to the points noted below. In the first Embodiment, no means is provided for coupling the inside protrusion 7 and the inside protrusion 15 in the longitudinal direction. Second Embodiment differs from the first embodiment in that means is provided for coupling the inside protrusion 7 and the inside protrusion 15.

As illustrated in Figure 4, the inside protrusion 15 is perforated by a slot 41. The inside protrusion 7 is perforated by a round hole 42. A rivet 43 is passed through the slot 41 and the round hole 42. Both ends of the rivet 43 are flattened so that the inside protrusion 7 and the inside protrusion 15 are loosely coupled in the longitudinal direction. The slot 41 takes the form of a single arc having the axis of rotation L as its center.

The angle over which the slot 41 extends from its top edge to its bottom edge with reference to the axis of rotation L is designated  $\theta$ . In Figure 4, this angle  $\theta$  is depicted approximately as the angle over which the slot 41 extends from its top edge to its bottom edge with reference to point O. The shaft of the rivet 43 is located in the vertical plane that contains the orthogonal line 24 and on the line that passes through point P. When the leg section rigid member 11 pivots relative to the rigid heel section 1, the rivet 43 moves approximately vertically within the slot 41.

#### Third Embodiment:

Figures 7, 8, and 9 depict a fundamental modification in which metal is substituted for resin as the material for the heel section, the rigid heel member, and the leg section rigid member of the leg section of the first and second embodiments. Figure 7 depicts a metal heel member 51 that constitutes the rigid heel member 1. Figure 8 and Figure 9 depict a metal member 51 of the rigid heel member 1 and a leg section metal member 56 of the leg section rigid member 11 in the assembled state.

Here, the metal member 56 is positioned behind the metal member 51, but the longitudinal relationship of the two elements is a matter of design. These metal members 51 and 56 are for use on the right foot. The

metal member 51 comprises a heel section 52 and a curved member 53 of band form. The heel section 52 rises at a backward incline from the central section of the curved member 53.

A spherical surface 54 is formed on the outside, i.e., the rear surface, of the heel section 52. A pivot hole 55 perforates the heel section 52. The metal member 56 is positioned above the heel section 52, and is coupled rotatably to the heel section 52 by a rotating shaft (not shown). The section of the metal member 56 that contacts the heel section 52 has a spherical surface that matches the spherical surface 54.

In Figure 7, the direction of snowboard travel is indicated by arrow A. The axis of rotation L of the metal member 56 is approximately orthogonal to the direction of travel and slopes slightly downward. That is, the axis of rotation L intersects the plane which contains the plane of the sole. The metal member 51 is perforated in several places by bolt holes 57.

The metal member 51 is fixed securely to the elastic shell of the snowboard boot by bolts (not shown) which pass through the bolt holes 57. The metal member 56 is also provided with a plurality of bolt holes 58 which are lined up in the vertical direction. The metal member 56 is fixed securely to the elastic shell of the snowboard boot by bolts (not shown) which pass through the bolt holes 58.

Now the pivoting/tilting structure shared by the first, second and third embodiments are to be described in detail:

The plane of approximate symmetry of each snowboard boot can be defined as follows. When the insides of both feet are placed together so as to touch lightly at two points while standing erect, the plane of approximate symmetry is the vertical plane that is parallel to the plane containing these two points, and that contains the back end point of the heel section, which has an approximately spherical surface shape. A right side plane of approximate symmetry SL and an left side plane of approximate symmetry SR defined according to these terms for the left and right foot are depicted in Figure 10.

In Figure 10, the direction that is usually designated as the direction of travel is indicated by arrow B. That is, the snowboard is propelled towards the left foot, which is generally the controlling foot. The major axis of the snowboard 61 is indicated by the number 62. The major axis 62 is parallel to the direction of travel B during straight forward advance. The left foot is the controlling foot, and, compared to the left foot, the right foot contributes almost nothing to propulsive force.

The snowboard is propelled in a way that at first appears to contradict the third law of motion. Where the right foot and the left foot exert equal force on the snowboard, the snowboard is not propelled forward since the snowboard and the rider are in an internal force relationship. To state the case in exaggerated terms, the pivoting/tilting structure for the right foot is not very important when the snowboard is propelled unidirectionally to the left.

The plane of approximate symmetry SL is inclined by 27° with respect to the orthogonal line 63 that is orthogonal to the longitudinal direction, i.e., the major axis 62 of the snowboard. The plane of approximate symmetry SL is inclined in such a way that the front of the foot is pointed more in the direction of travel than is the back of the foot. This 27° angle is an optimum value arrived at on the basis of a rule of thumb.

Of course, the optimum angle will differ depending on the degree of skill, the type of competition, and the individual characteristics of each rider. The pivoted section, which is the origin of the pivot position of the axis of rotation LL on the left side (the hinge member which is the intersection at which the axis of rotation LL intersects the heel section and the leg section), is offset to left from the plane of approximate symmetry SL. The angle of the axis of rotation LL and the plane of approximate symmetry SL is set at 30°. The axis of rotation LL is contained in an inclined plane which inclines inward at the front.

Usually, the angle formed by the plane of approximate symmetry SL and the inclined plane 64 (the vertical plane which contains the axis of rotation LL) is within the range of 23° to 33° for the foot that is located forward in the direction of travel. The angle formed by the plane of approximate symmetry and the orthogonal line 63 is within the range of 20° to 30° for the left foot.

For both feet, the angle formed by the plane of approximate symmetry SL and the inclined plane 64 is not smaller than the angle formed by the plane of approximate symmetry and the orthogonal line 63. For example, 30° versus 27°, as noted above. Under these conditions, the axis of rotation LL is approximately parallel to the orthogonal line 63. In the illustrated embodiments, the angle formed by the axis of rotation LL and the orthogonal line 63 is set to 3°, so these two are approximately parallel.

The plane of approximate symmetry SR is inclined by 6° away from the orthogonal line 63 which is orthogonal to the longitudinal direction, i.e., the major axis 62 of the snowboard. The plane of approximate symmetry SR is inclined in such a way that the front of the foot is pointed more in the direction of travel than is the back of the foot. This 6° angle is an optimum value arrived at on the basis of a rule of thumb. Therefore, the optimum angle will differ depending on the degree of skill, the type of competition, and the individual characteristics of each rider.

The pivoted section, which is the origin of the pivot position of the axis of rotation LR on the right side, is offset to left from the plane of approximate symmetry SR. The angle of the axis of rotation LR and the plane of approximate symmetry SR is set at 5°. Usually, the angle formed by the plane of approximate symmetry SR and the inclined plane 65 (the vertical plane which contains the axis of rotation LR) is within the range of 0° to 8° for the foot that is located to the rear in the direction of travel. The angle formed by the plane of approximate symmetry SR and the orthogonal line 63 is within the

range of 0° to 10° for the right foot.

The angle formed by the plane of approximate symmetry SR and the inclined plane 65 is not smaller than the angle formed by the plane of approximate symmetry SR and the orthogonal line 63. For example, 6° versus 5°, as noted above. Under these conditions, the axis of rotation LR is approximately parallel to the orthogonal line 63. In the illustrated embodiments, the angle formed by the axis of rotation LR and the orthogonal line 63 is set to 1°, so these two are approximately parallel. The axis of rotation LL and the axis of rotation LR intersect, in which case, the angle formed by the two is 4°. By shifting the body weight forward and moving the center of gravity of the body forward, the left foot (which is the controlling foot) becomes the principal point of action, and the snowboard is propelled forward, as depicted in Figure 11. In this case, the left foot is inclined more towards the front than is the right foot, as depicted in Figure 12. It is difficult to incline the foot to the left without inclining it forward.

Because of its three-dimensional arch structure, the foot does not readily rotate with the plane of approximate symmetry SL as the axis of rotation. Rather, the foot twists while inclining forward and rotates in a plane that is inclined with respect to the plane orthogonal to the plane of approximate symmetry SL. The angle of inclination is about 30° at the greatest the step-in location.

The foot is positioned in a rotated position rotated around the axis of rotation LL in the inclined plane 64 that is inclined about 30° with respect to the plane of approximate symmetry SL. The rotation mechanism of the leg section rigid member 11 is designed to faithfully reflect this restricted rotation mechanism of the foot. Thus, the foot can pivot together with the snowboard boot without undue strain.

The direction in which the foot pivots is approximately in the vertical plane which contains the major axis 62 of the snowboard. The shift in the center of gravity produced by pivoting of the foot effectively generates propulsive force in the direction of travel of the snowboard (direction B). With conventional pivot mechanisms, the force F applied to the snowboard by the foot produces a thrust of  $\cos(30) \cdot F$ . In addition, a bending motion which is at odds with the structure of the foot is required in order for this force F to be exhibited.

As illustrated in Figure 12, as an arbitrary point P located on a forward-leaning leg rotates around an axis 101 which extends in the longitudinal direction of the foot, the location of the point defined by dropping down from point P at a right angle to the horizontal plane shifts from Q1 to Q2. The straight line which connects Q1 and Q2 is parallel to the line 102 which is orthogonal to the axis 101. From the standpoint of the three-dimensional arch structure of the foot, such rotation is difficult.

When the foot rotates by an angle  $\gamma$  (not shown) on an axis defined by an inclined line 104 inclined inward from the axis 101 by a certain angle, point P shifts from Q1 to Q3. The straight line which connects Q1 and Q3

is parallel to the line 105 which is orthogonal to the inclined line 104 which is the axis in this case. From the standpoint of the three-dimensional arch structure of the foot, such rotation is easy. The fact that, under circumstances of a reasonable degree of rotation, the relationship between the angle of lateral rotation  $\gamma$  and the longitudinal angle  $\theta$  is such that  $\gamma = F(\theta)$  can be readily ascertained by bending the leg. This type of motion is used in snowboarding.

In piping competition, the direction of travel is both to the right and to the left. In this case, the plane of approximate symmetry is designed to be approximately orthogonal to the direction of the major axis of the snowboard. The inclined planes 64 and 65 are inclined at angle of less than 30° with respect to the plane of approximate symmetry. This has the advantage that even if a loss that reduces the component force in the direction of travel should be produced, the extent of the loss is less than that which would occur had bending of the foot not been facilitated.

#### Other Embodiments:

The hinge member of the snowboard boot which pertains to the present invention can be designed so as to be moveable. Continuous motion of the hinge member is not required. Insertion holes or the like can be provided in several locations for attaching the hinge member. When moving the position of the hinge member, the angle of incline of the axis of rotation may be changed as well.

The snowboard boot may be comprised of three layers, an inner and outer layer and a middle layer. With this three-layer structure, the cylindrical structure of the leg section and the heel section takes the form of a multi-layer cylindrical structure. This type of multi-layer cylindrical structure serves as a reinforcing structure for the snowboard boot. The hinge member is located in the middle layer of the three layers. Alternatively, where a two-layer or three-layer structure is adopted, the hinge member may be exposed at the exterior.

The snowboard boot which pertains to the present invention offers stable pivoting force and ease of control. The transmission efficiency of the propulsive force transmitted by the action of driving force by the foot on the snowboard is high. Mobility is enhanced.

#### Claims

1. A snowboard boot comprising a heel member (1) contained in the heel section (2) and a leg section (11) positioned above said heel member (1), the heel member (1) and the leg section (11) being attached so as to be capable of rotation around an axis of rotation, characterized in that the axis of rotation (L) inclines in the vertical direction at an angle of no more than  $\pm 45^\circ$  with respect to the horizontal and lies within an inclined plane which inclines forwards towards the inside with respect to

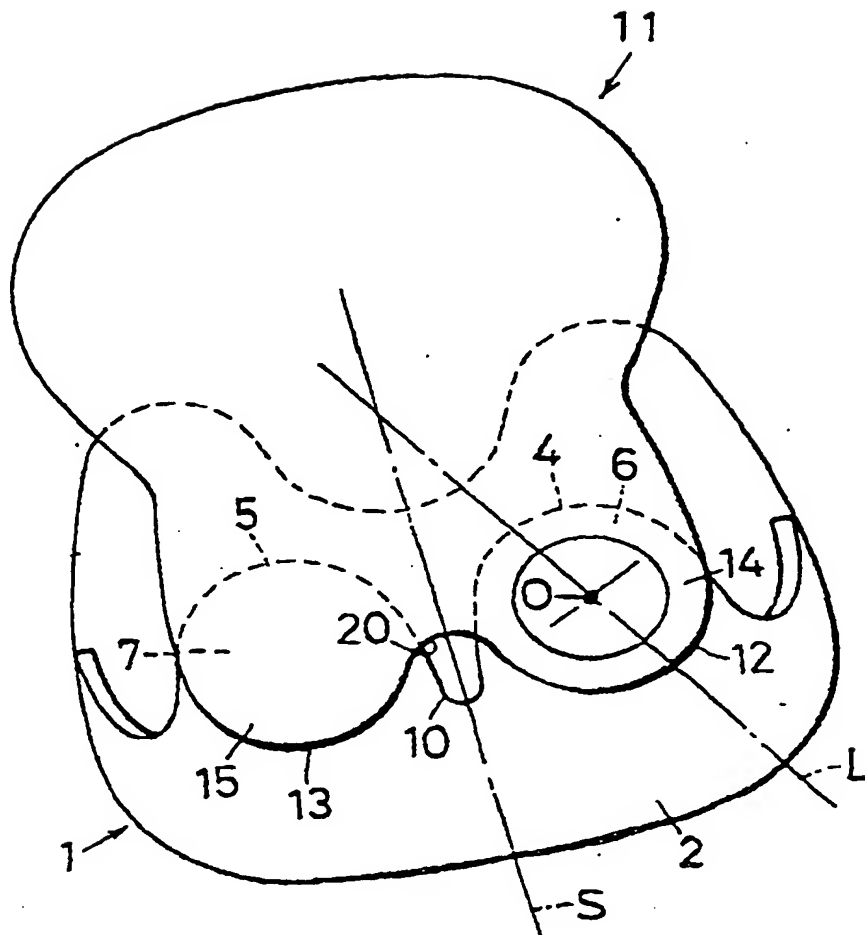


the plane of approximate symmetry (S) which divides the left and right sections of the heel section (11) into approximately symmetrical portions.

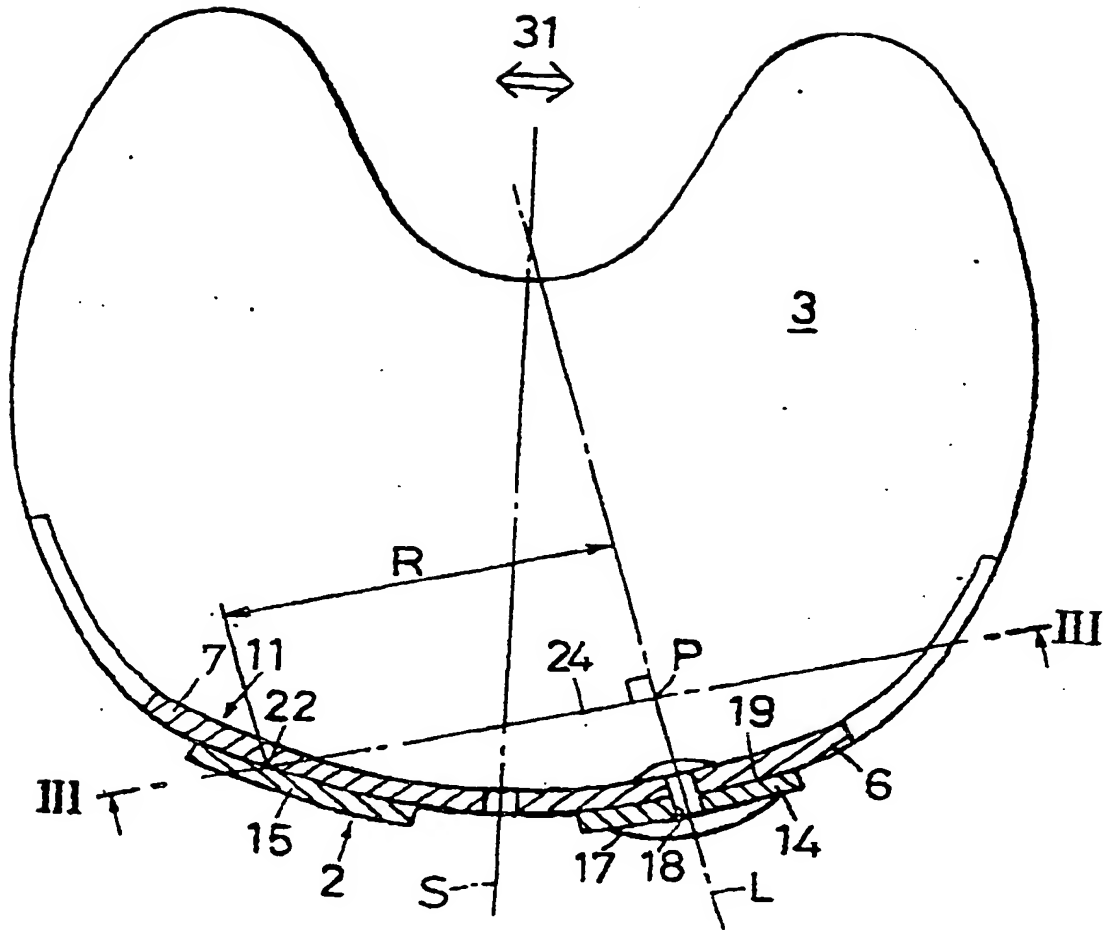
2. A snowboard boot as defined in claim 1, characterized in that the heel section (2) comprises a rigid heel member (1) and the leg section comprises a leg section rigid member (11). 5
3. A snowboard boot as defined in anyone of claims 1 to 3, characterized in that a hinge member (17, 18) is formed at the intersection at which the axis of rotation (2) intersects the heel section (2) and the leg section (11) and that said hinge member (17, 18) is positioned in an offset position which is offset from the plane of approximately symmetry (S). 10 15
4. A snowboard boot as defined in claim 2, characterized in that the offset position is offset towards the outside with respect to the plane of approximate symmetry (S). 20
5. A snowboard boot as defined in anyone of the preceding claims, characterized in that the axis of rotation (L) intersects the plane in which the sole lies. 25
6. A snowboard boot as defined in anyone of the preceding claims, characterized in that the angle formed by the plane of approximate symmetry (S) and the inclined plane is an angle within the range of 23° to 33°. 30
7. A snowboard boot as defined in claim 3, characterized by the fact that the hinge member (17, 18) is fabricated from metal. 35
8. A snowboard boot as defined in claim 3, characterized in that the hinge member (17, 18) is movable.
9. A snowboard boot as defined in claim 8, characterized in that the hinge member (17, 18) can be moved among a plurality of positions in the horizontal direction. 40
10. A snowboard boot as defined in anyone of the preceding claims, leg section comprise three layers, inner and outer layers and a middle layer, within overlap in the lengthwise direction, and that the hinge member (17, 18) is located in said middle layer. 45 50
11. A snowboard boot as defined in anyone of preceding claims 1 to 9, characterized in that the heel section (2) and the leg section comprise inner and outer layers which overlap in the lengthwise direction, and that hinge member (17, 18) is located in said outer layer. 55



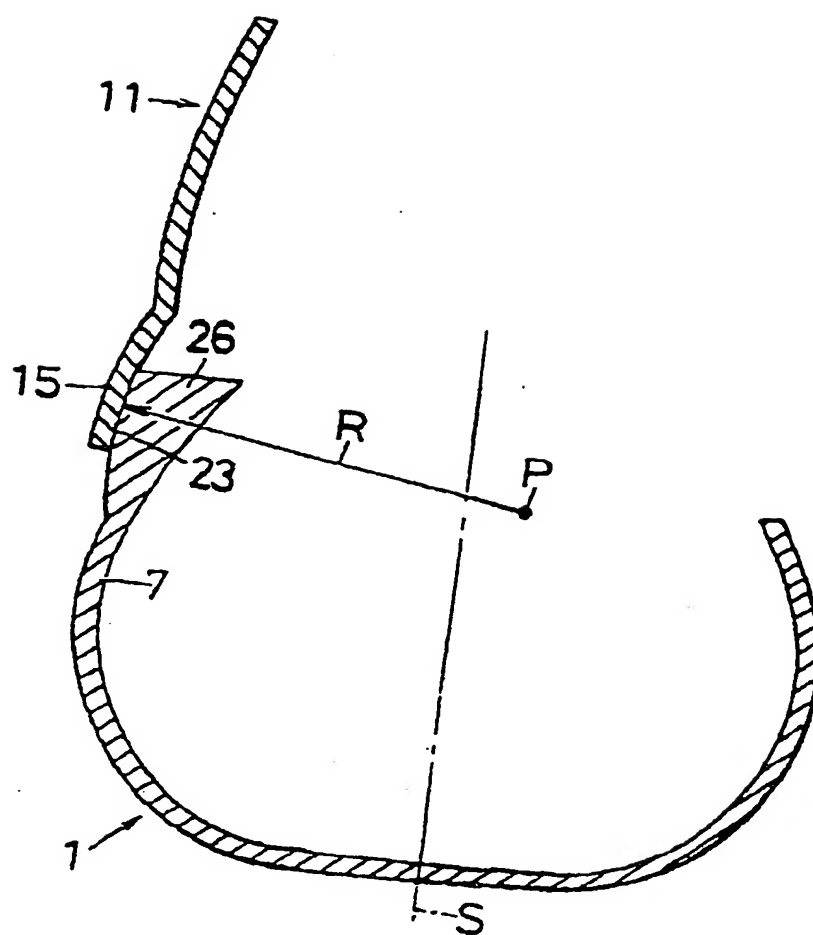
[ Figure 1 ]



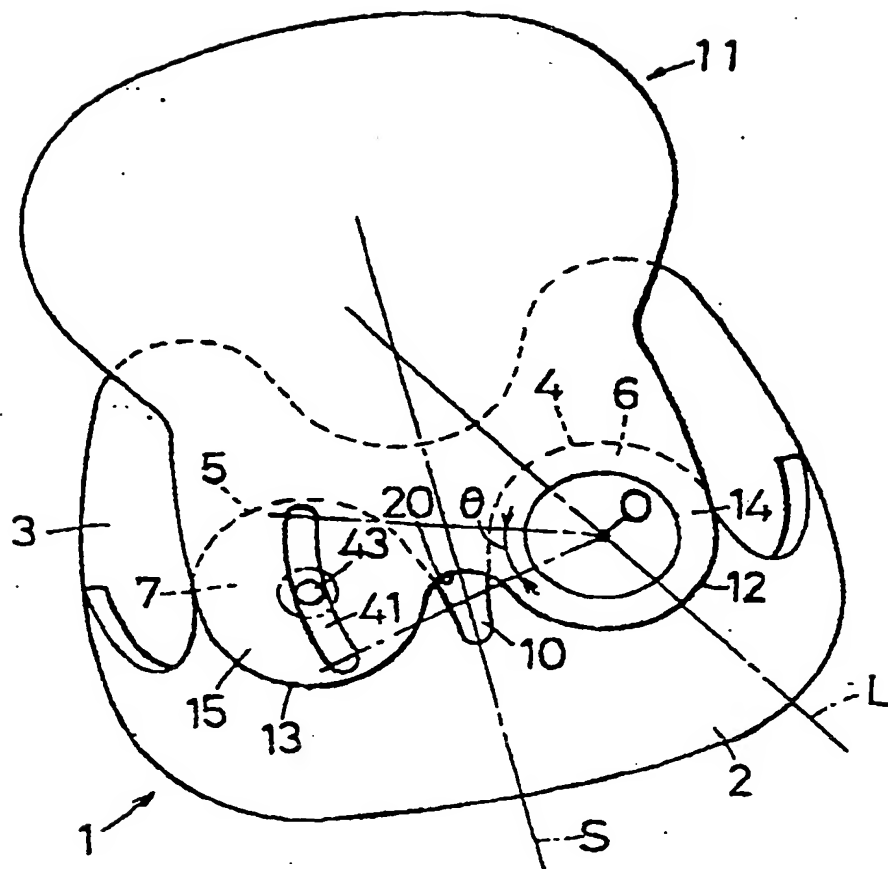
[ Figure 2 ]



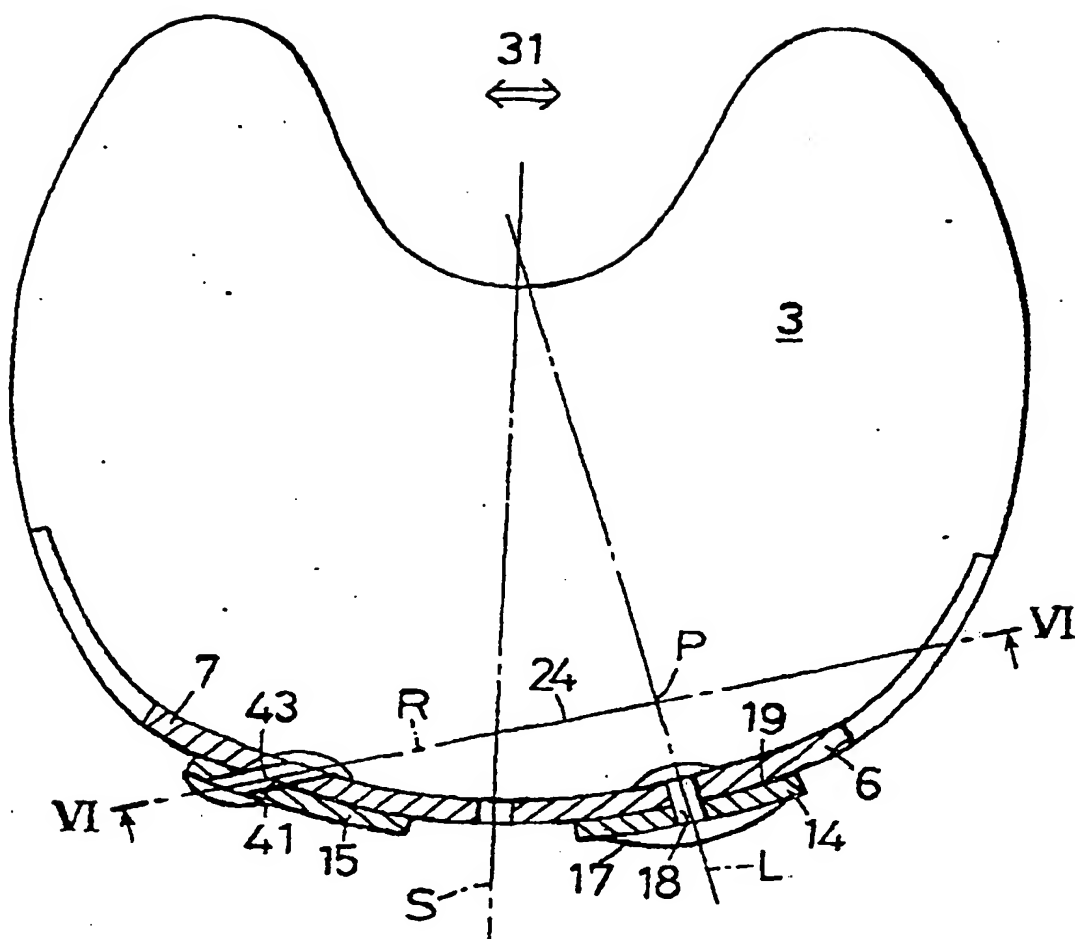
[ Figure 3 ]



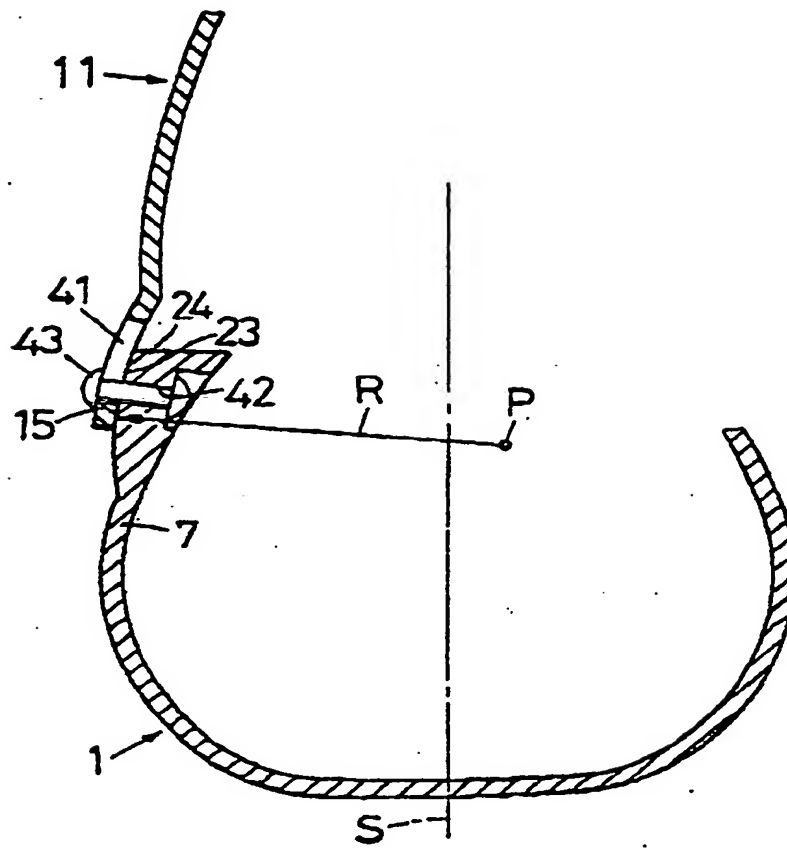
[ Figure 4 ]



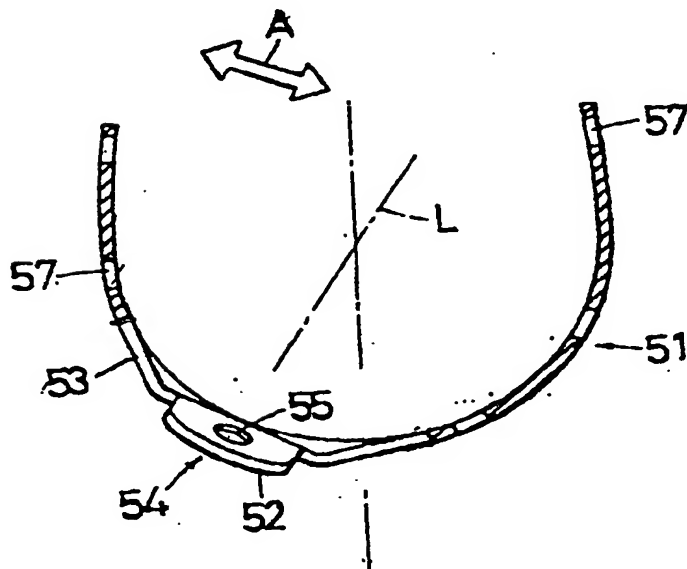
[ Figure 5 ]



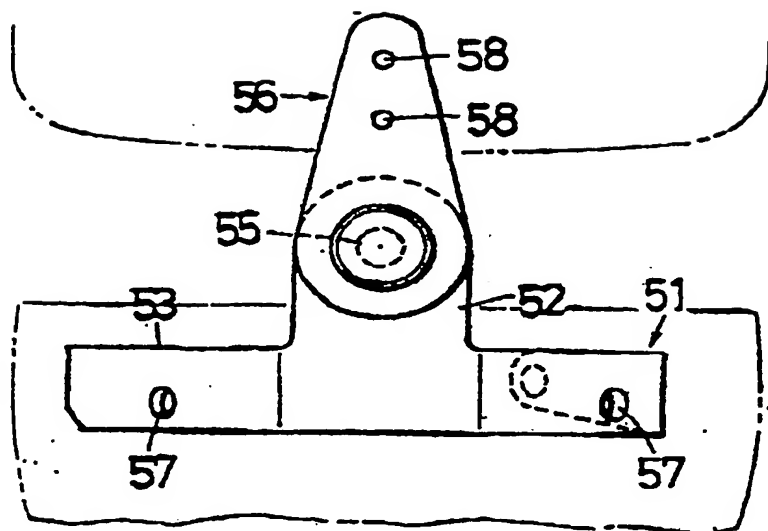
[ Figure 6 ]



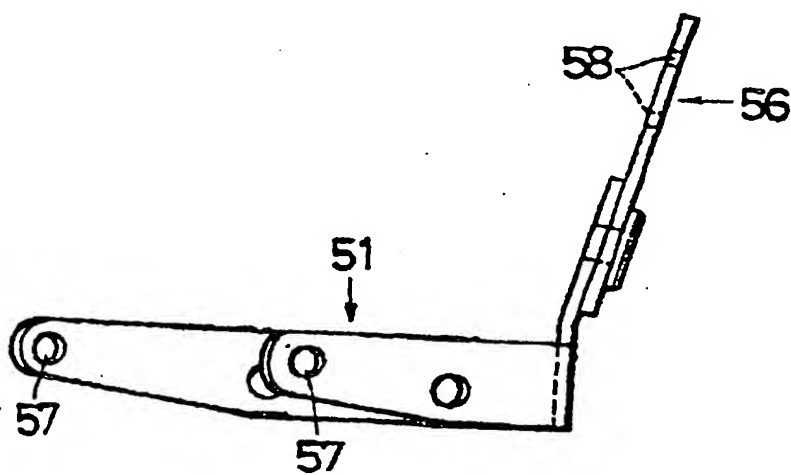
[ Figure 7 ]



[ Figure 8 ]

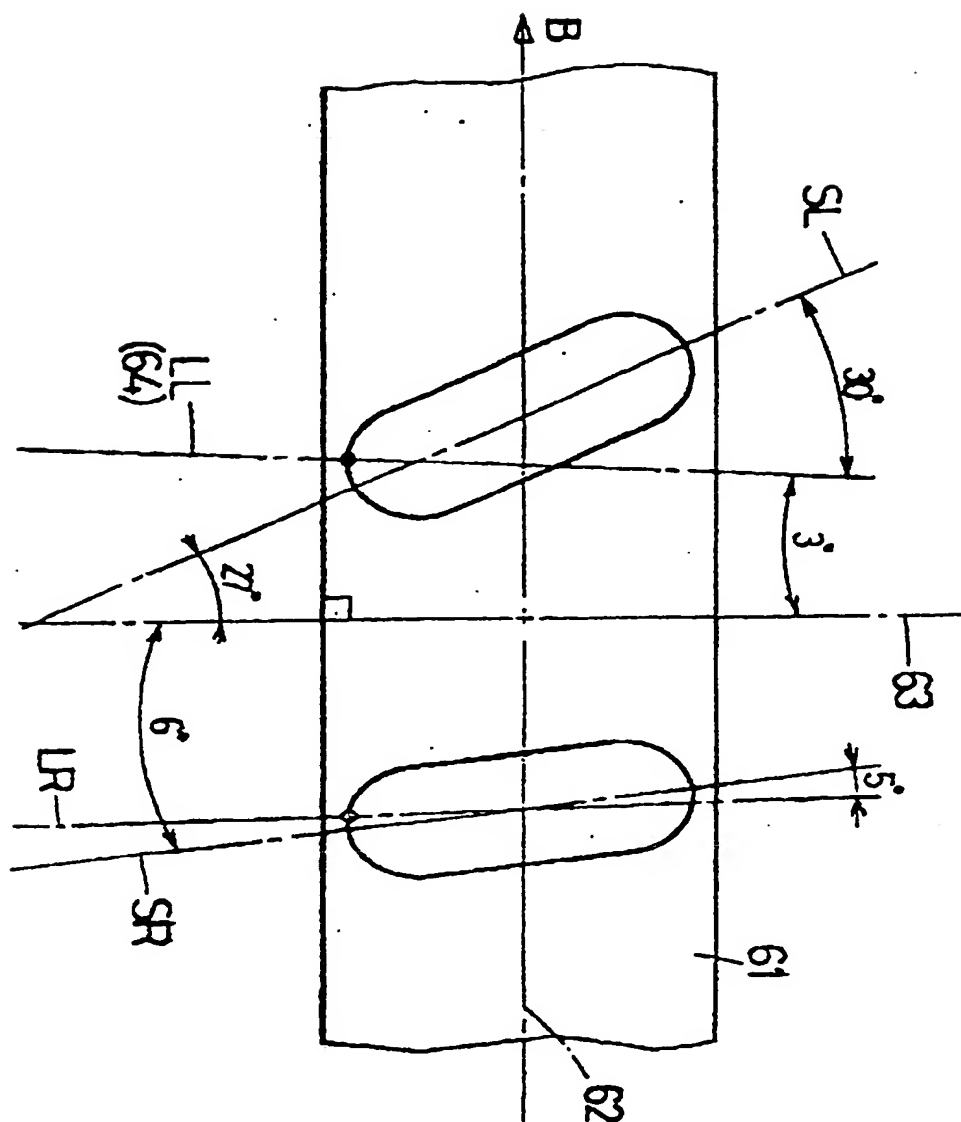


[ Figure 9 ]

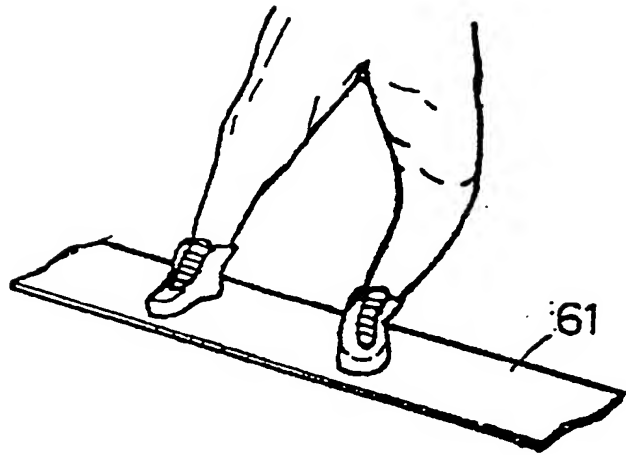




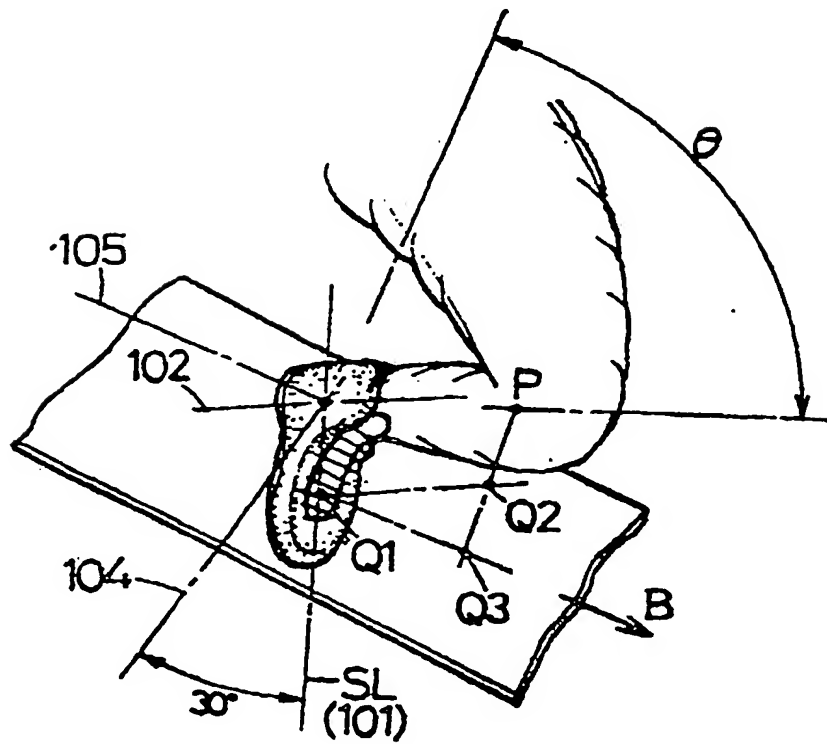
[ Figure 10 ]



[ Figure 11 ]



[ Figure 12 ]





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## EUROPEAN SEARCH REPORT

Application Number  
EP 96 10 9220

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CL.6)
A,D	FR-A-2 719 197 (SALOMON) * the whole document *	1	A43B5/04 A63C9/08
A,D	DE-A-43 33 503 (U.S.P.) * the whole document *	1	
A,D	DE-A-36 22 746 (M. LAEMMERT) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int. CL.6)
			A43B A63C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 November 1996	Examiner Declerck, J
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